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AUTHOR Anderson, Margaret B.
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ABSTRACT

This paper discusses the present status of the bibliographic database industry, reviews the development of online databases of interest to the petroleum industry, and considers future developments in online searching and their effect on libraries and information centers. Three groups of databases are described: (1) databases developed by the American Petroleum Institute (API), including APILIT (corresponding to "API Abstracts/Literature"), APIPAT (corresponding to "API Abstracts/Patents"), and P/E NEWS, which contains references to petroleum and energy business news; (2) the GeoRef database produced by the American Geological Institute (corresponding to "Bibliography and Index of Geology"); and (3) the Petroleum Abstracts or TULSA database, produced by the University of Tulsa (Oklahoma) (corresponding to the printed journal, "Petroleum Abstracts"). Other activities of the University of Tulsa Information Services Department are also described. A glossary of terms and a 27-item bibliography conclude the paper. (ESR)

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ONLINE PETROLEUM INDUSTRY BIBLIOGRAPHIC DATABASES: A REVIEW

U.S. DEPARTMENT OF EDUCATION
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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

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TEXAS WOMAN'S UNIVERSITY

SCHOOL OF LIBRARY SCIENCE

BY

MARGARET B. ANDERSON, B.A., B.S.

DENTON, TEXAS

MAY 1982

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IR 050 261

The Graduate School

Texas Woman's University

Denton, Texas

May 1982

We hereby recommend that the professional paper prepared under our supervision by Margaret B. Anderson entitled Online petroleum industry bibliographic databases: a review

be accepted as fulfilling this part of the requirements for the Degree of Master of Library Science.

Committee:

John J. Mintzer
Chairman

Frank L. Turner

Ina D. Cleveland

Accepted:

Provost of the Graduate School

TABLE OF CONTENTS

PREFACE		iv
Chapter I.	REVIEW	1
II.	API DATABASES	5
III.	GEOREF DATABASE	8
IV.	PETROLEUM ABSTRACTS (TULSA)	10
V.	FUTURE DEVELOPMENTS	20
APPENDIX		26
GLOSSARY		27
SELECTED BIBLIOGRAPHY		28

PREFACE

The purpose of this discussion is to review the information retrieval industry with special emphasis on the petroleum industry sponsored databases APILIT, APIPAT, and TULSA. Database producers fall into three primary categories: (1) government sponsored, (2) private non-profit professional societies and organizations, and (3) commercial publishing ventures. The primary petroleum industry producers fall in the second category. Since this discussion is limited to bibliographic databases, references to the development of MARC tapes by the Library of Congress and the evolution of shared networking and bibliographic utilities such as OCLC, RLIN, WLN, etc. are not discussed. These organizations benefited from the same advances in technology and software development as the bibliographic producers. Also excluded from this paper are the non-bibliographic and/or numerical databases. One that should be mentioned in discussion of the petroleum industry data bases is PDS (Petroleum Data System) developed by the University of Oklahoma. The PDS databases contain information on approximately 80,000 oil and gas fields and pools in the U.S. Production data is supplemented by crude oil analyses, gas analyses, brine analyses, secondary recovery projects,

and reserves. Source agencies include the U.S. Bureau of Mines, U.S. Department of Energy, state regulatory agencies, American Association of Petroleum Geologists, the Canadian provincial Conservation Boards, Dwights Energydata, and the International Oil Scouts Association. This database system is available using the GIPSY software package (originally developed under a federal grant to search the BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY) from the University of Oklahoma as a batch process through the GE Information Services Communications network. The experienced interactive online searcher will find both the delay (two to four hours minimum), and the inability to refine strategy decided drawbacks to the system. This is a very expensive database system to access.

Chapters of this paper discuss present status of the bibliographic database industry; review the development of the API databases, the GeoRef database, and the Petroleum Abstracts database and services; and suggest strategies for insuring that libraries/information centers have a viable role in the future society. In this chapter the end-user as a searcher is examined.

CHAPTER 1

REVIEW

Before we can discuss the future direction of the information retrieval industry with reference to the petroleum industry databases, a review is in order. As recently as 1972 most references searches were conducted manually. Most machine readable databases were privately or government owned and available to members and/or subscribers and usually available through inhouse searches from the database producer. A 1972 cooperative ASIS SIG/SDI--American Institute of Physics database survey listed 8 bibliographic databases as available while a LARC Association report identified 122 databanks and information sources. This latter publications includes some non-bibliographic databases. The 1981 Directory of Online Databases contains 641 entries covering approximately 770 databases and distinct files within database families.[1] Of this total approximately 33% are classed as bibliographic databases.

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[1]John H. Schneider, Marvin Gechman, and Stephen E. Furths, eds., Survey of Commercially Available Computer-readable bibliographic Databases. (Washington, D.C.: American Society for Information Science, 1973); Frank S. Patrinostro and Nathan Mulherin, comps. Available Data banks for library and information services, (Tempe, Arizona; LARC Association, 1973); and Directory of Online Databases 2 (Spring 1981).

The number of bibliographic databases has increased over 300% in less than ten years.

Early publicly available databases were by-products of the printed abstracting and indexing services. Tulsa, API, Chemical Abstracts Service, NLM, ERIC, etc. developed computerized techniques to facilitate computer typesetting and other data entry mechanisms for use in their printing and distribution processes. Federal funding provided background for the development of centers for computer-based searching. NASA's Regional Dissemination Centers and NSF's Office of Science Information Services centers are examples of this effort. The GeoRef database was partially funded by NSF fund from 1966 through mid-1974. Due to the limited scope and requirements of these federally funded centers, this process reached only a small portion of the nation's scientific community. One important development was the federal contracts to Lockheed and Systems Development Corporation to develop software for searching specific federal databases online. SDC developed the software for MEDLINE while Lockheed programmers where involved with NASA, ERIC, NTIS, and NAL databases.[2] Since the fundamental purpose of the database tapes was to support the printed publishing effort, no standardized indexing or format schemes were

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[2]Jeffrey J. Gardner and David M. Wax, "Online bibliographic services." Library Journal 101 (Sept. 15, 1976): 1828.

were developed. Current search analysts are still dealing with the problems created by this approach. We have no protocol, format, or database standards. Each vendor competes by introducing new databases and improving their inhouse software. The University of Tulsa's staff wanted to develop their own inhouse online system, but this was opposed by the advisory committee. The majority of the subscribers requested that the TULSA file be implemented on a trial basis on one of the established vendor's computers first. SDC was chosen as that vendor had both the API files and GEOREF availablle.

As the level of federal support decreased alternatives were developed. Lockheed and SDC began to aggressively market their available bibliographic databases. BRS was a late entrant into the field. Online time-sharing developed as the most economical alternative to batch processing; however, the technology and software lacked sophistication. SDC "ORBIT" initially established database "windows" or specific times when certain databases were available. If it were time for SDC to switch databases, a search on a particular database was either halted or lost in the transition. Of course, certain highly popular databases such as ERIC, NTIS, and Chemical Abstracts were available continuously.

Improvements in software include proximity searching left and/or right-hand truncation, and other techniques. Telecommunication networks are much more reliable. Inter-

national customers use satelites for data transmission. The expanded international customer base for U.S. produced databases is another example of the importance of these information databanks.

CHAPTER 2

API DATABASES

The CAIS (Central Abstracting and Indexing Service) of the American Petroleum Institute produces three bibliographic databases available currently online through SDC. These databases are APILIT, APIPAT, and P/E NEWS. The first two are the technical information files (literature and patent) covering the downstream[3] petroleum business. Subjects covered include petroleum refining, petrochemicals, and related technology. In 1980 CAIS added coverage of oilfield chemicals to their expanding list. The P/E NEWS database contains references to petroleum and energy business news from these sources: OIL & GAS JOURNAL, THE OIL DAILY, THE PETROLEUM ECONOMIST, PETROLEUM INTELLIGENCE WEEKLY, PLATT'S OILGRAM NEWS SERVICE, MIDDLE EAST ECONOMIC SURVEY, and at least six additional sources.[4] This database began in 1975 and is not indexed using the API Thesaurus. Natural language free-text searching is required for this database.

The hardcopy versions of APILIT and APIPAT are API ABSTRACTS/LITERATURE and API ABSTRACTS/PATENTS. Coverage of

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[3]This and other terms are explained in the glossary.

[4]Directory of Online Databases 2 (Spring 1981): 98.

the patent file changed in 1972 when API and Derwent Publications Ltd. entered a cooperative agreement. Significant changes in the patent coverage dating from that time include: (1) subject coverage enlarged, (2) 1964-1971 all abstracts indexed using API Thesaurus, (3) increased depth of indexing as result of API using the detailed Derwent documentation abstracts rather than previous abstracts. Since 1972, only a portion of the patent abstracts have been indexed using the API Thesaurus.

The similarities between APILIT and APIPAT outweigh the differences. Basically APILIT covers literature and APIPAT the patent citations. Minor format variations result from the different citation practices.[5]

API has an active subscriber committee. The subscriber committee establishes policy governing the information service through subcommittees and meets at least twice a year. CAIS was established in 1964 to integrate the various abstracting and indexing services of API. Manual abstract publications date from the mid 1950s. Various cooperative agreements between API-CAIS and the University of Tulsa have enabled both services to develop expertise in their respective downstream and upstream segments of the petroleum industry. API and University of Tulsa have developed appropriate subject controlled vocabularies utilizing an alphabetical thesaurus,

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[5]Anne Girad, Stuart M. Kaback, and Karen Landsberg, "APILIT and APIPAT: petroleum information online." Database 1 (December 1978): 46-67.

faceted hierarchy, and alphabetical index to the hierarchy. The thesarus must be consulted in developing a search strategy. Scope notes are provided in the thesaurus to indicate the changing validity of subject terms. Only the P/E NEWS is a natural language database. Services provided in the subscription package include printed API ABSTRACTS/LITERATURE and/or PATENTS weekly or monthly bulletins, Alphabetical Subject Indexes, Thesaurus, computer tapes similiar to those shipped to SDC, and unrestricted access to the online databases at SDC Search Service. Subscriptions to the API Technical Index (complete service) are available to either one or both services. Abstracts for APILIT and APIPAT are available online since 1978. A newsletter for online searchers is available from API/CAIS.

The feedback provided by the user-controlled committees for both API and TULSA has offered the producers the opportunity to improve and revise their respective databases to be "user friendly" and to take advantage of improving technology. The online abstracts for APILIT are an example of this feedback. Continued changes can be expected as the user-subscribers demand excellent performance and reliability. Individuals interested in a detailed review of the API databases are referred to the article by Girad, et.al.

CHAPTER III

GEOREF

The GeoRef database is frequently utilized by petroleum information specialists when searching for exploration literature. This database corresponds to the printed BIBLIOGRAPHY AND INDEX OF GEOLOGY which continues the BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY (1785-1970) prepared by the U.S. Geological Survey and the BIBLIOGRAPHY AND INDEX OF GEOLOGY EXCLUSIVE OF NORTH AMERICA (1933-1968) sponsored by the Geological Society of America.

The American Geological Institute contract for GeoRef began in 1966. In 1969 the first BIBLIOGRAPHY AND INDEX OF GEOLOGY was published as photocomposed from the GeoRef database. Funding for this effort was supported by a NSF grant. GeoRef went online at SDC in 1973. When the NSF funding expired in mid-1974, the Geological Society of America agreed to underwrite the cost of producing the database. Subscriptions to the hardcopy index were increased to cover portions of this expense. The first thesaurus and indexing guide was published in 1977 with funds obtained from several petroleum companies, This effort was primarily a guide to indexers, but was used by online searchers as all that was available. Subsequent editions are greatly improved.

In 1978 GeoRef added 125,000 backfile records. This backfile was obtained from the U.S. Geological Survey and Marathon Oil Company and included citations from GEOPHYSICAL ABSTRACTS 1966-1971, BIBLIOGRAPHY OF THESES IN GEOLOGY 1965-1966, and BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY 1961-1970. This added to the scope and usefulness of the file. Some duplication of records exists, but the material is available from a single source.

The American Geological Institute assumed all rights to GeoRef in 1979 and is now the sole publisher of GeoRef and the printed index. Online input and validation of data became operational during this time. GeoRef also is available from Lockheed DIALOG since 1981.

Future plans include adding over 280,000 backfile citations covering material from the BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY for 1785-1960 and the BIBLIOGRAPHY AND INDEX OF GEOLOGY EXCLUSIVE OF NORTH AMERICA for 1933-1966. Funds for this project are a grant from the U.S. Geological Survey.

Thus the petroleum industry has supported other databases in addition to the two services considered industry sponsored. Many of the developments and improvements in GeoRef parallel the developments of the API, TULSA, and the online searching industry in general. The development of standards or common strategies for compatible searching would would benefit all online users.

CHAPTER IV

PETROLEUM ABSTRACTS (TULSA)

The bibliographic database designed to cover the upstream segment of the petroleum industry is the PETROLEUM ABSTRACTS INFORMATION STORAGE AND RETRIEVAL SERVICES produced by the University of Tulsa. This database titled TULSA is available online from SDC and covers citations from 1965 to the present. Weekly updates have been supplied to SDC beginning in December 1981. The service also produced a manual system for 1961-1964. The PETROLEUM ABSTRACTS database contains citations relevant to the exploration, development, and production of petroleum resources. U.S. and foreign patents are included in this database. General subject sections include Geology; Geochemistry; Geophysics; Well drilling; Well logging; Well completion and servicing; Production of oil and gas; Reservoir engineering and recovery methods; Pipelining shipping, and storage; Ecology and pollution; Alternate fuels and energy sources; Supplemental technology; and Mineral commodities. The last section, Mineral commodities, does not include an abstract in the printed weekly bulletin, nor is the indexing as complete as for the other subdivisions. Abstracts are not presently available online, but are available in a printed bulletin.

The need for an abstracting and indexing service covering the petroleum exploration and production industry was discussed at the 1960 Special Libraries Association Petroleum Section sponsored Forum on Abstracting and Indexing Petroleum Exploration and Production Literature. Over 200 interested representatives (librarians and technical specialists) attended. Several proposals were made including one requesting that API (American Petroleum Institute) expand its abstracting and indexing services to include upstream literature. Another proposal was presented by the Denver Research Institute. The University of Tulsa system based on Jersey Production Research Company's (Exxon) card files and indexing system became a reality. Jersey had donated materials card files and a building to the petroleum engineering department of the University of Tulsa.

The first Subscriber Advisory Committee meeting was held September 27-28, 1962 in Tulsa, Oklahoma. The first subcommittee (Information Storage and Retrieval Subcommittee) was established to: (1) consider changing the present card format to a system better adapted to mechanization and information retrieval requirements, (2) review selection policies and set new selection policies and guidelines, (3) prepare a thesaurus, and (4) review the classification system. One of the most noticeable differences between API/CAIS and TULSA is the purpose of this Subscribers Advisory Committee. Whereas API subscriber committee members set policy, the Petroleum Abstract subscribers only <u>recommend</u> and <u>suggest</u>

changes. The university administration is responsible for policy and implementation. Voting membership in the Subscriber Advisory Committee is open to one representative from each major subscriber who wishes to participate. A major subscriber is defined as one having over $10 million in capital assets excluding governmental agencies and universities. In 1962 the service had 17 major subscribers and 44 minor subscribers. By 1980 the service had grown to 73 major subscribers and search file licensees.

The functions of the Subscriber Advisory Committee are to:

1: review Petroleum Abstract service publications to assure maintenance of quality and effectiveness in selection, abstracting, and indexing current literature and patents;

2: periodically review the retrospective, single copy reproduction, and indexing services to assure quality and required type of service;

3: determine type, nature, and extent of other information services required;

4: assist in planning and development of new services and changes in existing services; and

5: provide guidance concerning problems and activities that may arise.[6] Subscriber representatives continue

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[6]University of Tulsa Information Services Department. Minutes of the Petroleum Abstracts Subscribers Advisory Committee Meeting. Tulsa, March 29, 1963. Appendix I. Tulsa: University of Tulsa, 1963.

serve on thesaurus development, database correction, and other special committees as a need is perceived either by the university or subscribers.

The E & P Thesaurus was first published in 1965 and represented many workhours by API and Petroleum Abstracts committee members. The E & P Thesaurus is compatible with the API Subject Authority List. This thesaurus was compiled in a format similiar to that used in the "Thesaurus of Engineering Terms" published by the Engineers Joint Council. Although subsequent editions are similiar in format, the philosophy used in building the hierarchies is different. Refinements and additions are incorporated into the later editions to reflect both experience with the terms and new technologies. The Information Services Department maintains an online-updated version for production of the retrieval services.

At the time the first edition of API s Subject Authority List and Petroleum Abstract's E & P Thesaurus were published both organizations were well into the planning and development of computerized retrieval services. This was one of the primary purposes for compatibility. API began preparing their database on computer tapes in 1964 while the Petroleum Abstracts Service began in 1965. An Alphabetical Subject Index and Dual Dictionary Coordinate Index became available for both retrieval services. These were designed for manual searches. The ASI's are computer produced tools developed for current information or browsing techniques. It is not designed

as a tool for comprehensive searching, but does include author and accession number indices. The Dual Dictionaries or DD's were also computer produced and designed for exhaustive searching that can be done without access to a computer (ie. manually).[7]

The third information retrieval tool offered by both services was the computer tapes covering the indexing documentation for each document. Subscribers to the services could obtain the computer tapes and search inhouse on either or both databases utilizing the same strategy. Software for searching was supplied to those subscribers requesting the programs. These searches were and are still primarily processed as offline "batch" searches by most organizations. During this related time period NLM began developing MEDLARS and offering it to subscribers.

In 1970 the Information Services Department began publishing ECONOMICS MINERALS ABSTRACTS. This service was disbanded as the department could not obtain enough subscribers to pay for the costs of indexing and publishing this abstracting and indexing journal. Also completed during this same time was a correction and update tape to replace the master record tapes for 1965-1969. This corrected tape brought all indexing to the standard then in effect (1970 edition of the E & P Thesaurus). Subscriber representatives identified problem areas and served as consultants.

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[7]Examples can be found in the Appendix.

The year 1973 saw several changes in the service. The format of the printed bulletin was changed from a card (four per page) to a vertical page format. This change was necessary to offset the rising cost of printing. The service also dropped its card service and began sending subscribers microfilm copies of the bulletin at biannually intervals in place of 4x6 cards of each abstract. During 1973 the Information Services Department developed an interactive online search system called PASS (Petroleum Abstracts Search System). This service was offered to subscribers at a reduced rate and nonsubscribers for substantially higher fees and on a regulated basis. The department's professional staff conducted the the searches for the requestors. The original aim was to provide telecommunications access for subscribers wishing to search online themselves; however, hardware and priority problems at the University's computer center precluded this arrangement. A proposal by Systems Development Corporation to provide Petroleum Abstracts subscribers online access to the database was presented by one of the committee members at the May 1974 Subscribers Advisory Committee Meeting. SDC was beginning to offer the API databases and GeoRef and felt the Petroleum Abstracts database was a logical extension of this subject expansion. The university would have to pay the costs for loading the database at SDC and guarantee a certain minimum hours of usage. A test of the upgraded PASS system was also proposed to determine the advisability of using this slightly less sophisticated system rather than

an outside vendor such as SDC. Several subscriber companies volunteered to conduct the tests. Problems were encountered with the PASS system. Of primary considerations was the low priority assigned by the University of Tulsa's computer center to this database. By the spring of 1975 it became evident to a number of subscribers that the Information Services Department intended to implement the PASS system and not evaluate the SDC proposal. Several representatives met prior to the scheduled Advisory Committee meeting to formulate a common proposal concerning the online use of the Petroleum Abstracts database. This group agreed that the University should sign an contract with SDC and provide online access for its subscribers. Problems of access for foreign subscribers was one of the considerations. A united front at the committee meeting was felt to be essential. At this meeting, the subscribers refused to endorse the PASS proposal and lobbied with the University administration to evaluate the SDC alternative. As a result, a contract with SDC was signed and TULSA became available on ORBIT in October 1975.

From 1975 through 1977 the TULSA database was open to all SDC customers. Since the subscription fees for the retrieval services are designed to underwrite the expense of producing and maintaining the database, the subscribers and the University agreed to "close" the file in January 1978 to all non-subscribers. Organizations and individuals desiring access to the database could pay a search licence

fee to the University and have access to TULSA at a higher rate that subscribers. The cost of this license fee was determined to be equal to the subscription fee minus the cost for the indices, thesauri, and other subscription components. Licencing fee users pay 57% more than the major subscribers but the same as minor subscribers to access the database at SDC. Costs are $70/hour for major subscribers versus $125/hour for non-subscribers and minor subscribers.

A major component of the Petroleum Abstract Service is its document delivery service available from the University of Tulsa's Sidney Born Technical Library. This library receives the copies of the journals, books, and patents abstracted and indexed by the Information Services Department. Although the technical library is a separate administrative unit of the University, subscribers consider this service essential to the total package. Organizations maintaining deposit accounts may order single copies of most items by the Petroleum Abstract accession number. Special forms are available from the library. The library also will collect copyright fees for the Copyright Clearinghouse Center for its customers. Support for this service was evident when the subscribers perceived a lack of communication within the University administration concerning its importance to the industry. Subscribers expressed their support with letters and verbal communications with the University administration.

Thus, the TULSA database is only one component in the services provided by the University of Tulsa Information Services Department. Weekly printed abstract bulletins (PETROLEUM ABSTRACTS) are distributed the same week as a master record tape is prepared for SDC. Subscribers maintaining their own inhouse computer files receive monthly or bi-monthly tapes. Additional materials and services include bi-monthly and annual printed cummulative Alphabetical Subject Indexes, descriptor frequency lists, computer search tapes, E & P Thesaurus, Geographic Thesaurus, document delivery and searches by the Information Services Department staff.

Subscribers again influenced the University when hardware and software problems created excessive backlogs. At one time, over 5,000 items had been indexed but not entered into the database as a result of these problems. The department was also behind in data entry for a special Department of Energy grant whereby approximately 10,000 Petroleum Abstract records were keyboarded into DOE specifications.

At the fall 1931 Committee Meeting two priorities emerged. The first is the publication of new corrected and updated editons of both thesauri and the cummulative editions of the 1980 ASI's. The second is the development of strategies for add abstracts to the SDC online database. Machine-readable abstracts have been prepared since January 1978. An oil field bibliography based on the Department's historical card files

would also be advantageous to industry users. The desirability of adding this restrospective information to the database was discussed. The file will be loaded into the ORBIT IV with corrections during 1982. Subscribers have been invited by SDC to participate in the test of this corrected file.

The Petroleum Abstracts database and services will continue to expand and improve as it meets the changing information environment. The department now has its own minicomputer for processing. Technological improvements are incorporated as required. The ability of this service to respond to changes is directly attributable to the input and concern of the subscriber representatives.

CHAPTER V

FUTURE DEVELOPMENTS

Where does this detailed review of one industry's response to the information explosion lead us? Since the 1973 Arab Oil Embargo, interest in energy and information about energy resources has greatly increased. NTIS, Gulf/ENERGY, ENERGYLINE, ENERGY (EDB--DOE sponsored) and other databases have increased their coverage and popularity. There are so many databases and sources to access that it is difficult to decide where to begin. Advantages of APILIT, APIPAT, and TULSA are their length of coverage, specialization of subject content, detailed subject thesauri, and their responsiveness to user demands. Although the subscriber committees serve different functions, both producers listen to their users. These committees are composed of information specialists and/or managers.

The future direction of the information industry is a popular topic with writers. Libraries and information centers are predicted to fade away into archival nonentities. The role of libraries and/or information centers as the middleman in interactive online retrieval will decrease as users develop the sophistication to access the databases directly from their home or office computers or terminals. As this trend in-

creases, end-users will attempt to conduct their own online searches. Martha Williams states that if information retrieval is to become really widespread, the investigator or end-user must do his/her own searching.[8] Meadows presents the view that end-users will eventually become routine database searchers, using a parallel with the development of programming and programmers, as his basis. Originally programming was the specialized field of mathematicians, now individuals (end-users) compile their own programs as a step in the completion of their own work. Meadows considers interactive database searching a high level computer programming effort and thus subject to the same evolution.[9] Such development will allow librarians/information specialists to engage in more professional activities such as teaching and problem-solving.

Currently the information specialist acts as a translator between the investigator/end-user and the complex web of databases, bibliographic utilities, language, and vendor protocol. Access to the machine-readable information by the end-user has been impeded by the design of online systems, by the multiplicity of available retrieval systems, by variations

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[8]Martha E. Williams. "Future directions for machine-readable data bases and their use," in 1979 Clinic on Library Application of Data Processing, ed. Frederick Wilfrid Lancaster (Chicago : University of Illinois Press, 1979), : 84.

[9]Charles T. Meadow. "ONLINE searching and computer programming: some behavioral similarities..." Online 3 (January 1979): 51.

in individual databases, and by the proliferation of these databases. In order for the end-user to retrieve information effectively login in and logoff protocols, command grammar, conventions for defining functions and procedures, techniques for array handling, output format options, and editing functions must be simplified. This clarification would also increase the productivity of the librarian searcher.

Standards are one possible method for solving this problem. Standardization of the online retrieval services is unlikely due to the vast number of organizations and individuals involved. Some components involved in such a process include databases, subject access methodology, the recording media, the command languages and software, telecommunication systems and hardware. The industry is now worldwide standards would necessarily have to incorporate divergent requirements and functions. As an example of the complexity of this process the following items would have to be addressed in order to establish database standards:

1. Content--identifying which database elements should be included in a particular search service.

2. Data representation--for each element or item within a record--indicating character code and character set.

3. Form--of term contained in a record--indicating whether they are abbreviated, coded, or fully spelled out.

4. Format--indicating spacing and sequencing of data elements within a record.

5. Representation on a recording medium--physical characteristics, physical format, and logical format; and

6. Subject access or subject analyses--classification schemes, natural language, key works, etc. [10]

An alternative to standards is the development of a distributed, integrated system utilizing converters to access protocols, translate languages, reprocess control languages, handling the system responses and messages, selectors to determine which database or system would satisfy a query; automatic routers to access multiple databases; evaluators to provide feedback; and analyzers to examine the query results.

Various experts have tried to predict future developments in society and its usage of information and information processing technology. Computer hardware will continue to expand the trend to more for less, but alternate storage and switching mechanisms must be developed. Bubble memories and new electronic switching devices will increase the storage and retrieval capabilities of computers. Software will be developed to process this data. Computers and other technological aspects of electronic technology will be fully integrated into society. Politics and information will be increasingly mixed. Governments will require massive amounts of information, but freedom of access for all must be protected.

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[10]Martha E. Williams. "Future directions for machine-readable data bases and their use." : 86-87.

The citizen's right to acquire information and express himself through the existing media system must be protected and individuals must be assured that information technology will help guarantee these fundamental rights of equality and privacy. Computers and integrated systems are viewed as elitist. These systems must acquire a democratic connotation to be accepted by society at large.

As increasing volumes of information are stored in computers, less will be available in paper. The paperless society will not evolve completely as individuals will still require paper for personal referral. New concepts of publication will develop. For example, since the production of published material will be in machine-readable form, copies will never go out-of-print but be easily produced on demand on the requestor's terminal facility. Integrated office systems will facilitate rapid retrieval of information. As end-users conduct their own searches, they will then query the library terminal for document access. Satellites will be utilized for varied data transmission requirements. Videotex and videodisc, electronic mail, and increased networking will expand the library's role in this future society. Database producers and bibliographic utilities who are responsive to the changing requirements of the user base will succeed. The Wright and Hawkins bibliography[11] lists 86 annotated

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[11]William F. Wright and Donald T. Hawkins. "Information technology: a bibliography." Special Libraries 72 (April 1981): 163.

citations on technological innovations that have had or are expected to have an impact on libraries.

Society might not recognize the physical format of a twenty-first century library/information center, but librarians should be able to discern the functions and problem-activities that must be considered professional librarianship.

APPENDIX

SAMPLE PAGES FROM PETROLEUM ABSTRACTS ASI and DUAL DICTIONARY

BIBLIOGRAPHY

BIBLIOGRAPHY OF AFCRL PUBLICATIONS FROM 1 OCTOBER TO 31 DECEMBER 1968 — 110,784

*LITERATURE — *LITERATURE SEARCH
*US AIR FORCE OFF SCI RES — *GEOPHYSICAL EXPLORATION
*LASER — *MATHEMATICAL ANALYSIS
*OPTICS — *MICROWAVE
*REPORT

REPORTS AND MAPS OF THE GEOLOGICAL SURVEY RELEASED ONLY IN THE OPEN FILES, 1968 — 110,745

*GEOLOGIC MAP — *LITERATURE
*US GEOLOGICAL SURVEY — *ECONOMIC GEOLOGY
*PETROLOGY — *REGIONAL GEOLOGY
*SEDIMENTATION — *STRATIGRAPHY
*STRUCTURAL GEOLOGY

AERIAL PHOTOGRAPHS DESCRIPTIVE CATALOG OF SELECTED AERIAL PHOTOGRAPHS OF GEOLOGIC FEATURES IN AREAS OUTSIDE THE UNITED STATES — 111,523

ARCTIC AREA—RECENT POLAR LITERATURE — 110,760

ATLANTIC COAST (USA)—ATLANTIC CONTINENTAL SHELF AND SLOPE OF THE UNITED STATES — 107,117

AUSTRALIA—PALAEOBOTANY AND PALYNOLOGY IN AUSTRALIA A HISTORICAL REVIEW — 110,442

AUSTRIA—1967 ANNUAL REPORT OF THE AUSTRIAN GEOLOGICAL SURVEY — 117,756

BAHAMA ISLANDS—BIBLIOGRAPHY ON THE BAHAMA ISLANDS — 110,763

BRYOZOA—BIBLIOGRAPHY AND LIST (1900-1965) OF THE FAMILIES CONSTELLARIIDAE AND CRIBRILITIDAE (ECTOPROCTA, CHEILOSTOMATA) — 110,766

BUBBLE [illegible]—BUBBLE AND CROP PHENOMENA — 110,765

CALIFORNIA—INDEX TO GEOLOGIC MAPS OF CALIFORNIA, 1961-1966 — 113,138

CALIFORNIA—INDEX TO GRADUATE THESES ON CALIFORNIA GEOLOGY--1966 AND 1967 — 110,656

CALIFORNIA—WHERE DOES THE HAYWARD FAULT GO — 111,796

CARBONATE ROCKS—SELECTIVE, ANNOTATED BIBLIOGRAPHY ON CARBONATE AREAS — 109,7[illegible]

CARIBBEAN AREA—BIBLIOGRAPHY OF RECENT BENTHONIC FORAMINIFERA OF THE CARIBBEAN AREA — 107,574

CEPHALOPODA—CATALOG OF THE TYPE SPECIMENS OF INVERTEBRATE FOSSILS PT 1 PALEOZOIC CEPHALOPODA — 106,855

CEPHALOPODA—RECENT LITERATURE ON MESOZOIC AMMONITES-PT 10 — 119,513

CHROMATOGRAPHY—BIBLIOGRAPHY OF PAPER AND THIN-LAYER

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(1191)

.106,640	.109,711	.109,612	.107,163	.107,574	.106,855	.108,284	.107,117	.104,578	.107,629
.109,650	.110,601	.110,442	.108,243	.108,704	.108,295	.110,744	.107,877	.106,638	.108,244
.106,660	.110,781	.113,782	.108,293	.110,354	.110,525	.111,556	.111,567	.107,618	.110,199
.109,230	.112,361	.114,062	.111,523	.112,674	.110,705	.111,596	.111,937	.110,609	.110,779
.110,780	.113,441	.117,962	.113,513	.114,774	.111,935	.111,796	.117,767	.110,678	.111,849
.111,910	.113,751	.120,192	.116,363	.114,784	.113,805	.113,174	.118,667	.113,134	.112,709
.112,910	.114,241	.121,932	.116,763	.114,804	.114,005	.114,656	.118,697	.115,058	.113,809
.113,660	.114,681	.	.117,623	.115,704	.114,785	.115,018	.118,937	.115,519	.117,259
.115,710	.118,571	.	.120,503	.116,974	.115,809	.115,326	.120,097	.118,668	.117,619
.116,740	.120,361	.	.120,853	.118,624	.116,675	.116,766	.	.118,998	.117,959
.118,660	.120,391	.	.	.120,364	.118,975	.117,796	.	.	.118,649
.118,660	.121,031	.	.	.	.118,965	.118,646	.	.	.
.118,870	.	.	.	.	.119,565	.118,626	.	.	.
.119,140	.	.	.	.	.119,845	.118,664	.	.	.
.119,915	.	.	.	.	.120,365	.118,926	.	.	.
.121,940	.	.	.	.	.122,095	.119,606	.	.	.
.	.	.	.	.	.	.120,836	.	.	.

GLOSSARY

API/CAIS: American Petroleum Institute. Central Abstracting and Indexing Service.

APILIT: Bibliographic database produced by API/CAIS covering the petroleum refining literature citations.

APILIT: Bibliographic database produced by API/CAIS covering the petroleum refining patent citations.

BIBLIOGRAPHIC DATABASE: Organized set of machine readable records containing bibliographic or document related citations and, sometimes, abstracts of the printed literature (ie. journal articles, reports, patents, dissertations, books, conference proceedings, or newspaper items).

DOWNSTREAM: Refers to petroleum industry operations beyond the producing phase of the business, ie. refining and marketing.

GEOREF: Bibliographic database produced by the American Geological Institute covering geological and geophisical literature citations.

LARC: Association for Library Automation in Research Communications.

P/E NEWS: Bibliographic database produced by API/CAIS covering petroleum industry business news.

SIG/SDI: Special Interest Group for Selective Dissemination of Information (special ASIS committee).

TULSA: Bibliographic database produced by the University of Tulsa covering petroleum exploration and production patents and literature.

UPSTREAM: Refers to petroleum industry operations up to and including the production phase of the business.

VIDEOTEX: Delivery of text or graphic information to the home at a low cost through various terminal/cable TV systems.

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